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(54) PRODUCTION OF WATER-ABSORBING RESIN MOLDING

(57)Abstract:

PURPOSE: To obtain a water-absorbing resin molding having uniform and stable water absorption properties by adding a specific water-soluble polymer to a resin, successively molding the mixture into a prescribed shape and irradiating the resultant molding with an ionizing radiation and active rays.

—AXAR₂—

I

CONSTITUTION: A water-soluble polymer consisting of a recurring unit of formula I [A is an unit composed of a recurring units of formula II and formula III (R₁ is a hydrocarbon), wherein formula II exists in an amount of ≥70wt.% and its recurring number is positive number and the recurring number of formula III is 0 or positive number; X is an organic compound residue having 2 active hydrogen groups; R₂ is a dicarboxylic acid, dicarboxylic anhydride, etc.] is added to a resin to prepare a resin composition and the resin composition is molded into a prescribed shape and the resultant molding is irradiated with at least either one of ionizing radiation and active rays to provide the objective resin molding.

—CH₂ CH₂ O—

II

Furthermore, the water-soluble polymer is preferably obtained by reacting a specific polyoxyalkylene polyol with at least one compound of a dicarboxylic acid (anhydride), etc.



III

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CLAIMS

[Claim(s)]

[Claim 1] The process of the absorptivity resin Plastic solid characterized by having the process which adds the water-soluble-polymer compound which consists of repeat units expressed with the following general formula (1) by the resin, and produces a resin constituent, the process which fabricates the above-mentioned resin constituent in a predetermined configuration, and produces a Plastic solid, and the process which irradiates either [at least] an ionizing radiation or an activity beam of light at the above-mentioned Plastic solid.

[Formula 1]



上記式 (1) において、Aは

R₁

—CH₂—CH₂—O— と —CH₂—C(=O)R₁— の繰り返しから構成される単位である (ただし、A中に上記 —CH₂—CH₂—O— が 70 重量%以上存在し、—CH₂—CH₂—O— の繰り返し数が正数であり、

R₁
—C(=O)R₁— の繰り返し数が 0 または正数である。また R₁ は炭化水素基である。)。Xは活性水素基を 2 個有する有機化合物の残基であり、R₂ はジカルボン酸、ジカルボン酸無水物、ジカルボン酸の低級アルキルエステルまたはジイソシアネート化合物の残基である。

[Claim 2] The process of the absorptivity resin Plastic solid according to claim 1 whose water-soluble-polymer compound expressed with a general formula (1) is a with a weight average molecular weight of 30000 or more water-soluble-polymer compound to which make the following (A) and (B) come to react.

(A) The with a weight average molecular weight of 1000 or more polyoxyalkylene polyol which comes to carry out the addition polymerization of the alkylene oxide which contains ethylene oxide 50% of the weight or more to the organic compound which has two active hydrogen machines.

(B) At least one compound chosen from the group which consists of the low-grade alkyl ester and the diisocyanate compound of a dicarboxylic acid, a dicarboxylic-acid anhydride, and a dicarboxylic acid.

[Translation done.]

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DETAILED DESCRIPTION**[Detailed Description of the Invention]****[0001]**

[Industrial Application] This invention relates to the process of the absorptivity resin Plastic solid which gives absorptivity to the usual resin.

[0002]

[Description of the Prior Art] From the former, since resins, such as a polyolefine, do not have absorptivity, static electricity occurs or it has problems, like there is no drip nature. Therefore, with the mold goods using the above-mentioned resin, especially the film, by preventing generating of static electricity by adding an antistatic agent, or adding a drip, the contact angle of the waterdrop on the front face of a film is enlarged, it blooms cloudy, and prevention is aimed at. Furthermore, in recent years, scouring an absorptivity resin to the above-mentioned resin, and giving absorptivity to it is proposed.

[0003]

[Problem(s) to be Solved by the Invention] however, the thing for which water is incorporated inside a resin even if it adds a drip as mentioned above -- there is nothing -- the performance degradation in a fixed period -- especially, on the outskirts of a cooling machine, such as a refrigerator and an air conditioner, dew condensation water drips and generating of omission etc. is seen Moreover, also in the method of adding an absorptivity resin to the above-mentioned resin, since the conventional absorptivity resin does not have thermoplasticity, it is difficult to distribute a resin uniformly. And in order to add the above-mentioned absorptivity resin and to give absorptivity, it must add so much, consequently the fall of an original resin property will be brought about.

[0004] This invention sets offer of the process of the absorptivity resin Plastic solid equipped with homogeneity and the stable absorptivity as the purpose, without reducing the property of the resin which was made in view of such a situation and serves as a base material.

[0005]

[Means for Solving the Problem] The composition of having had the process which fabricates the process which the process of the absorptivity resin Plastic solid of this invention adds the water-soluble-polymer compound which consists of repeat units expressed with the following general formula (1) by the resin, and produces a resin constituent, and the above-mentioned resin constituent in a predetermined configuration in order to attain the above-mentioned purpose, and produces a Plastic solid, and the process which irradiates either [at least] an ionizing radiation or an activity beam of light at the above-mentioned Plastic solid is taken.

[Formula 2]

上記式 (1) において、Aは

R₁

—CH₂—CH₂—O—と—CH₂—CHO—の繰り返しから構成される単位である（ただし、A中に上記—CH₂—CH₂—O—が70重量%以上存在し、—CH₂—CH₂—O—の繰り返し数が正数であり、

R₁

—CH₂—CHO—の繰り返し数が0または正数である。またR₁は炭化水素基である。） Xは活性水素基を2個有する有機化合物の残基であり、R₂はジカルボン酸、ジカルボン酸無水物、ジカルボン酸の低級アルキルエステルまたはジイソシアネート化合物の残基である。

[0006]

[Function] That is, this invention persons repeated a series of researches, in order to obtain the absorptivity resin Plastic solid equipped with the absorptivity stabilized without reducing the physical properties of the original resin used as a base material. By the conventional absorptivity resin added in order to give absorptivity to the resin used as a base material in process of the research, since it did not have thermoplasticity, things other than the usual absorptivity resin were examined from it being difficult to make it mix uniformly. And it recollects using the special water-soluble-polymer compound which consists of repeat units which replace with the conventional absorptivity resin and are expressed with the above-mentioned general formula (1). This special water-soluble-polymer compound has the comparatively good miscibility to the resin of varieties, and the property is changed to water-soluble shell absorptivity by moreover irradiating an ionizing radiation and an activity beam of light. therefore, the resin used as a base material -- the above -- after adding a special water-soluble-polymer compound, producing a resin constituent and fabricating to a desired Plastic solid using this resin constituent, an ionizing radiation and an activity beam of light are irradiated at the above-mentioned Plastic solid going via such a manufacturing process -- the above -- the property changed to absorptivity and was not eluted in water, but the special water-soluble-polymer compound found out that the Plastic solid equipped with homogeneity and the stable absorptivity comes to be obtained, and reached this invention.

[0007] Below, this invention is explained in detail.

[0008] The resin used as a base material and the special water-soluble-polymer compound added to the above-mentioned resin are used for the absorptivity resin Plastic solid manufactured by this invention.

[0009] If it is possible as a resin used as the above-mentioned base material to hold the target performance after ionizing radiation and activity beam-of-light irradiation in the process of this invention, it will not limit especially. For example, polyethylene, ethylene vinyl acetate, polypropylene, polystyrene, acrylic styrene, a polyvinyl chloride, a polyethylene terephthalate, a polybutylene terephthalate, nylon, etc. are raised.

[0010] The special water-soluble-polymer compound added to the above-mentioned resin consists of repeat units expressed with the following general formula (1).

[0011]

[Formula 3]



上記式 (1) において、Aは

$\text{---CH}_2\text{---CH}_2\text{---O---}$ と $\text{---CH}_2\text{---CHO---}$ の繰り返しから構成される単位である (ただし、A中に上記 $\text{---CH}_2\text{---CH}_2\text{---O---}$ が 70 重量%以上存在し、 $\text{---CH}_2\text{---CH}_2\text{---O---}$ の繰り返し数が正数であり、

$\text{---CH}_2\text{---CHO---}$ の繰り返し数が 0 または正数である。また R₁ は炭化水素基である。)。Xは活性水素基を 2 個有する有機化合物の残基であり、R₂ はジカルボン酸、ジカルボン酸無水物、ジカルボン酸の低級アルキルエステルまたはジイソシアネート化合物の残基である。

[0012] The inside of the above-mentioned formula (1), and R₁ It sets and especially a methyl group, an ethyl group, and a phenyl group are desirable. Moreover, as for the weight average molecular weight of the above-mentioned water-soluble-polymer compound, 30,000 or more are desirable. It is 100,000-200,000 especially preferably. Such a specific water-soluble-polymer compound is obtained using two components shown below, (A), and (B).

[0013] (A) The with a weight average molecular weight of 1000 or more polyoxyalkylene polyol which comes to carry out the addition polymerization of the alkylene oxide which contains ethylene oxide 50% of the weight or more to the organic compound which has two active hydrogen machines.

(B) At least one compound chosen from the group which consists of the low-grade alkyl ester and the diisocyanate compound of a dicarboxylic acid, a dicarboxylic-acid anhydride, and a dicarboxylic acid.

[0014] As an organic compound which has the two above-mentioned active hydrogen machines, amines, such as alicyclic diols, such as ethylene glycol, a diethylene glycol, a propylene glycol, a dipropylene glycol, 1, 4-butanediol, 1, 6-hexandiol, neopentyl glycol, bisphenol A, a polytetramethylene glycol, a cyclohexane -1, and 4-dimethanol, a butylamine, an octyl amine, a lauryl amine, a cyclohexylamine, and an aniline, are raised, for example. These are independent or are used collectively.

[0015] Moreover, as an alkylene oxide which contains the ethylene oxide which carries out addition polymerization to the

organic compound which has the two above-mentioned active hydrogen machines more than 50 % of the weight (it abbreviates to "%" below), alkylene-oxide mixture, such as ethylene oxide independence, a propylene oxide which contains ethylene oxide 50% or more, butylene oxide, and a styrene oxide, is raised. The water-soluble-polymer compound which the content of the above-mentioned ethylene oxide serves as water-insoluble nature, and uses for this invention by less than 50% of the whole alkylene oxide is not obtained, and is not suitable.

[0016] As the above (B), a dicarboxylic acid, a dicarboxylic-acid anhydride, the low-grade alkyl ester of a dicarboxylic acid, and a diisocyanate compound are raised. These are independent, or are combined two or more sorts and used. As the above-mentioned dicarboxylic acid, a phthalic acid, an isophthalic acid, a terephthalic acid, a malonic acid, a succinic acid, a sebacic acid, a maleic acid, a fumaric acid, an adipic acid, an itaconic acid, etc. are raised. And as the above-mentioned dicarboxylic-acid anhydride, the anhydride of the various above-mentioned dicarboxylic acids is raised. Moreover, as low-grade alkyl ester of the above-mentioned dicarboxylic acid, the methyl ester of the various above-mentioned dicarboxylic acids, dimethyl ester, ethyl ester, diethyl ester, propyl ester, dipropyl ester, etc. are raised. Furthermore, specifically as the above-mentioned diisocyanate compound, a tolylene diisocyanate, diphenylmethane diisocyanate, hexamethylene

di-isocyanate, isophorone diisocyanate, xylenediisocyanate, 4, and 4-methylene-screw (cyclohexyl isocyanate) etc. is raised. [0017] The special water-soluble-polymer compound used for this invention is manufactured as follows, for example. That is, it is made to react at the temperature of about 90-200 degrees C by making caustic alkalis, such as a sodium hydroxide and a potassium hydroxide, into a catalyst first for 2 to 30 hours, using the organic compound which has the two above-mentioned active hydrogen machines, and the alkylene oxide which contains ethylene oxide 50% or more, and it is random and a polyoxyalkylene polyol is manufactured for the alkylene oxide which contains ethylene oxide 50% or more in the organic compound which has two active hydrogen machines a block or by carrying out addition polymerization.

[0018] 1000 or more are [weight average molecular weight] desirable especially desirable, and the polyoxyalkylene polyols obtained using each above-mentioned component are 5000-30000. That is, it is because an ionizing radiation and the inclination for the absorptivity after activity beam-of-light irradiation to get worse are seen since the addition rate of the connection agent of the dicarboxylic-acids compound of the above (B) with which weight average molecular weight corresponds less than by 1000, and a diisocyanate compound increases.

[0019] Subsequently, a water-soluble-polymer compound is manufactured by making the above-mentioned polyoxyalkylene polyol (A) and (B) react. First, the case where (B) is a dicarboxylic acid, a dicarboxylic-acid anhydride, and the dicarboxylic-acids compound (B1) that is low-grade alkyl ester of a dicarboxylic acid is described. That is, after adding the above (B1) to the above-mentioned polyoxyalkylene polyol (A), a temperature up is carried out and it is obtained by making it reduced pressure of 0.001 - 20mmHg, and performing dehydration or dealcoholization to the bottom of 80-250-degree C heating. As reaction time in the meantime, it is usually 30 minutes - 10 hours.

[0020] And specifically, the blending ratio of coal (A/B1) of both at the time of making the above-mentioned polyoxyalkylene polyol (A) and a dicarboxylic-acids compound (B1) react is equivalent ratio, and it is desirable to set it as A/B 1= 1 / the range of 1.05 - 1/3.50.

[0021] Below, the case where the above (B) is a diisocyanate compound is described. That is, the urethane-ized reaction in the case of a diisocyanate compound mixes the blending ratio of coal of for example, a polyoxyalkylene polyol and a diisocyanate compound within the limits of NCO/OH equivalent ratio 0.5-1.5, and is performed by making it react for 1 to 5 hours 80-150 degrees C. You may use dibutyltin dilaurate etc. for this urethane reaction as a well-known catalyst.

[0022] Thus, the water-soluble-polymer compound obtained consists of repeat units expressed with the following general formula (1).

[0023]

[Formula 4]
 $\text{--}\langle\text{AXAR}_2\rangle\text{--} \cdots \quad (1)$

上記式 (1) において、Aは

R_1

$\langle\text{CH}_2\text{CH}_2\text{O}\rangle$ と $\langle\text{CH}_2\text{CHO}\rangle$ の繰り返しから構成される単位である (ただし、A中に上記 $\langle\text{CH}_2\text{CH}_2\text{O}\rangle$ が70重量%以上存在し、 $\langle\text{CH}_2\text{CH}_2\text{O}\rangle$ の繰り返し数が正数であり、

R_1
 $\langle\text{CH}_2\text{CHO}\rangle$ の繰り返し数が0または正数である。また R_1 は炭化水素基である。)。Xは活性水素基を2個有する有機化合物の残基であり、 R_2 はジカルボン酸、ジカルボン酸無水物、ジカルボン酸の低級アルキルエステルまたはジイソシアネート化合物の残基である。

[0024] and the above -- as mentioned above, setting or more to 30,000 is desirable especially desirable, and the weight average molecular weight of a special water-soluble-polymer compound is 100,000-200,000 That is, it becomes difficult for a water absorption scale factor to be small and for weight average molecular weight to fall less than with 30,000 on desired conditions. Moreover, it is because the inclination it to become difficult greatly to mix melt viscosity to a resin will be seen if weight average molecular weight exceeds 200,000.

[0025] in addition, the above -- in order to prevent the heat deterioration of the water-soluble-polymer compound at the time of going via the time of the addition to the resin of a water-soluble-polymer compound, and the manufacturing process of a Plastic solid, you may add a heat-resistant stabilizer to a special water-soluble-polymer compound Especially if heat deterioration is prevented about the above-mentioned heat-resistant stabilizer, it will not restrict about the kind and addition of the stabilizer.

[0026] The process of the absorptivity resin Plastic solid of this invention is performed as follows, for example. That is, this is added to a resin using the above-mentioned water-soluble-polymer compound. Although it does not limit as this addition method especially if mixture is uniformly possible, generally it is desirable to carry out melting mixture, to cool and to pelletize using an extruder. Although the cooling method by water is usually raised as the above-mentioned cooling method, in order to use a water-soluble-polymer compound, in this invention, air cooling is desirable. Subsequently, a resin Plastic solid is produced with the making machine for fabricating in a desired configuration using the above-mentioned pellet. And the water-soluble-polymer compound added by irradiating either [at least] an ionizing radiation or an activity beam of light is made to construct a bridge over the above-mentioned resin Plastic solid, it changes into a water-absorbing resin, and an absorptivity resin Plastic solid is manufactured.

[0027] As for the addition of the water-soluble-polymer compound to the resin which is a base material, in the above-mentioned process, it is desirable to set up to 5 - 20% to a resin. That is, it is because the inclination for resin physical properties to fall will be seen if it is difficult for the addition of a water-soluble-polymer compound to give desired absorptivity in the resin Plastic solid obtained at less than 5% and it exceeds 20%.

[0028] And as an ionizing radiation which irradiates the above-mentioned resin Plastic solid, an electron ray, a gamma ray, an X-ray, etc. are raised, for example. Moreover, ultraviolet rays and a visible ray are raised as the above-mentioned activity beam of light. The irradiation purpose of the above-mentioned ionizing radiation and an activity beam of light is for making construct a bridge the water-soluble-polymer compound uniformly mixed by the resin and carrying out water insolubilization, and water-absorbing-resin-izing. As irradiation conditions for the electron ray and gamma ray which are the above-mentioned ionizing radiation, it is desirable to set it as the range of 1 - 20Mrad as dosage. That is, it is because it becomes insufficient less than 1 Mrad] constructing [of a water-soluble-polymer compound] a bridge quantity of radiation, and the inclination not to insolubilize and for crosslinking density to become high and for a water absorption power to fall will be further seen if quantity of radiation exceeds 20Mrad(s). It is desirable to set wavelength as 254nm or less as irradiation conditions for an activity beam of light on the other hand. And about irradiation time, a water-soluble-polymer compound constructs a bridge and an ionizing radiation and an activity beam of light are not limited that what is necessary is to just be formed [especially] in a water-absorbing resin.

[0029]

[Effect of the Invention] as mentioned above, this invention -- first -- a resin -- the above -- a special water-soluble-polymer compound is added and a resin constituent is produced Subsequently, the above-mentioned resin constituent is fabricated in a predetermined configuration, and a Plastic solid is produced. And an absorptivity resin Plastic solid is manufactured by irradiating either [at least] an ionizing radiation or an activity beam of light at the above-mentioned Plastic solid. For this reason, as for the special water-soluble-polymer compound in the above-mentioned Plastic solid, what the property equipped with homogeneity and the stable absorptivity as an absorptivity resin Plastic solid which changes to absorptivity, consequently is obtained is obtained. and the above used for this invention -- a special water-soluble-polymer compound becomes possible giving absorptivity comparatively, to various resins according to the purpose of use to the resin of varieties, since miscibility is good]

[0030] Below, it combines with the example of comparison and an example is explained.

[0031]

[Example 1] The dimethyl sebacic-acid 2.4 section was added to the polyethylene-glycol (molecular weight 10000) 100 section which carried out the addition polymerization of the ethylene oxide to ethylene glycol independently by the usual method, the ester exchange reaction was performed by the aforementioned method, and the water-soluble-polymer compound of molecular weight 150,000 was obtained [in the repeat unit expressed with the aforementioned general formula (1), A, X, and R2 are as follows].

[0032]

[Formula 5]

A : $\text{CH}_2\text{CH}_2\text{O}$ —

X : $-\text{OCH}_2\text{CH}_2\text{O}-$

R₂ : $-\text{OC}(\text{CH}_2)_2\text{CO}-$

[0033] and the obtained water-soluble-polymer compound -- using -- this -- a low density polyethylene (Mitsubishi polyethylene LD LM40, diamond polymer company make) -- receiving -- 5% -- it added and the extruder performed melting mixture at 170 degrees C so that it might become comparatively, it extruded to the filamentose and air cooling was performed. This was judged by the strand cutter and the pellet was obtained. Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 170 degrees C using the injection molding machine. And the absorptivity resin Plastic solid which uses an electron ray for the resin Plastic solid of the shape of an above-mentioned strip of paper, irradiates quantity-of-radiation 10Mrad, and is made into the purpose was obtained.

[0034]

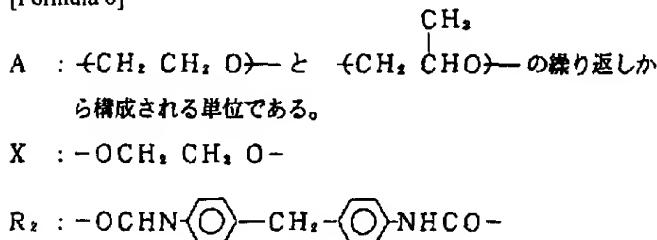
[Examples 2 and 3] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The absorptive resin Plastic solid made into the purpose like an example 1 was obtained except it.

[0035]

[Example 4] The addition polymerization of the propylene oxide is conventionally carried out to a propylene glycol by the well-known method, and, subsequently it is the usual method about ethylene oxide. The diphenylmethane diisocyanate 1.1 section was added to the polyethylene polypropylene-glycol (15 % of the weight [of propylene-oxide contents], 85 % of the weight [of ethylene oxide contents], molecular weight 20000) 100 section which carried out addition polymerization, the urethane-ized reaction was performed in 85-90 degree-Cx 90 minutes, and the water-soluble-polymer compound of molecular weight 170,000 was obtained [in the repeat unit expressed with the aforementioned general formula (1), A, X, and R2 are as follows].

[0036]

[Formula 6]



[0037] and the obtained water-soluble-polymer compound -- using -- this -- a low density polyethylene (Mitsubishi polyethylene LD LM40, diamond polymer company make) -- receiving -- 5% -- it added so that it might become comparatively, and the pellet was produced like the example 1 Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 170 degrees C using the injection molding machine. And the absorptivity resin Plastic solid which uses an electron ray for the resin Plastic solid of the shape of an above-mentioned strip of paper, irradiates quantity-of-radiation 10Mrad, and is made into the purpose was obtained.

[0038]

[Examples 5 and 6] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The absorptivity resin Plastic solid made into the purpose like an example 4 was obtained except it.

[0039]

[Example 7] the water-soluble-polymer compound produced in the example 1 -- an ethylene-vinyl acetate copolymer (EVA) (EVA41H, diamond polymer company make) -- receiving -- 5% -- it added and the extruder performed melting mixture at 150 degrees C so that it might become comparatively, it extruded to the filamentose and air cooling was performed This was judged by the strand cutter and the pellet was obtained. Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 150 degrees C using the injection molding machine. And the absorptivity resin Plastic solid which uses a gamma ray for the resin Plastic solid of the shape of an above-mentioned strip of paper, irradiates quantity-of-radiation 10Mrad, and is made into the purpose was obtained.

[0040]

[Examples 8 and 9] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The absorptivity resin Plastic solid made into the purpose like an example 7 was obtained except it.

[0041]

[Example 10] the water-soluble-polymer compound produced in the example 4 -- an ethylene-vinyl acetate copolymer (EVA) (EVA41H, diamond polymer company make) -- receiving -- 5% -- it added and the extruder performed melting mixture at 150 degrees C so that it might become comparatively, it extruded to the filamentose and air cooling was performed This was judged by the strand cutter and the pellet was obtained. Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 150 degrees C using the injection molding machine. And the absorptivity resin Plastic solid which uses a gamma ray for the resin Plastic solid of the shape of an above-mentioned strip of paper, irradiates quantity-of-radiation 10Mrad, and is made into the purpose was obtained.

[0042]

[Examples 11 and 12] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The absorptivity resin Plastic solid made into the purpose like an example 10 was obtained except it.

[0043]

[The example 1 of comparison] the water-soluble-polymer compound produced in the example 1 -- a low density polyethylene (Mitsubishi polyethylene LD LM40, diamond polymer company make) -- receiving -- 5% -- it added and the extruder performed melting mixture at 170 degrees C so that it might become comparatively, it extruded to the filamentose and air cooling was performed This was judged by the strand cutter and the pellet was obtained. Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 170 degrees C using the injection molding machine.

[0044]

[The examples 2 and 3 of comparison] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The resin Plastic solid made into the purpose like the example 1 of comparison was obtained except it.

[0045]

[The example 4 of comparison] the water-soluble-polymer compound produced in the example 1 -- an ethylene-vinyl acetate copolymer (EVA) (EVA41H, diamond polymer company make) -- receiving -- 5% -- it added and the extruder performed melting mixture at 170 degrees C so that it might become comparatively, it extruded to the filamentose and air cooling was performed This was judged by the strand cutter and the pellet was obtained. Subsequently, the resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained for the obtained pellet at 170 degrees C using the injection molding machine.

[0046]

[The examples 5 and 6 of comparison] The addition of a water-soluble-polymer compound was changed to 10% and 20%, respectively. The resin Plastic solid made into the purpose like the example 4 of comparison was obtained except it.

[0047]

[The example 7 of comparison] The resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained at 170 degrees C with the injection molding machine using the low density polyethylene (Mitsubishi polyethylene LD LM40, diamond polymer company make).

[0048]

[The example 8 of comparison] The resin Plastic solid of the shape of a strip of paper with a size of 3x10x0.4cm was obtained at 170 degrees C with the injection molding machine using the ethylene-vinyl acetate copolymer (EVA) (EVA41H, diamond polymer company make).

[0049] Thus, using the sample which is the example article and the example article of comparison which were obtained, about absorptivity and hygroscopicity, the following method was followed, and it measured and evaluated. The result is shown in the after-mentioned Table 1 and 2.

[0050] [Water absorption test] Reduced pressure drying was performed for the sample at 80 degrees C for 3 hours. Then, after leaving it in a dryness desiccator for 2 hours, the sample weight (K) was measured. Subsequently, the sample was taken out after being underwater immersed for two weeks, the attached groundwater on the front face of a sample was wiped off, and the weight (L) was measured. Then, after were air-dry, performing reduced pressure drying for 3 hours and leaving it in a dryness desiccator for 2 hours, the sample weight (M) was measured. And the coefficient of water absorption and the elution volume were computed by the formula shown below, respectively.

[0051] Coefficient-of-water-absorption (%) = $(L-K)/L \times 100$ elution-volume (%) = $100 - [(K-M)/K \times 100]$

[0052] [Hygroscopic examination] Reduced pressure drying was performed for the sample at 80 degrees C for 3 hours. Then, after leaving it in a dryness desiccator for 2 hours, the sample weight (K) was measured. subsequently, a sample -- the constant temperature of 20 degree-Cx80%RH -- it took out and the weight (L') was measured, after leaving it for two weeks in the constant humidity inside of a plane And the amount of moisture absorption was computed by the formula shown below.

[0053]

Amount (%) of moisture absorption = $(L'-K)/L' \times 100$. [0054]

[Table 1]

		水溶性高分子化合物添加量(%)	吸水量(%)	溶出量(%)	吸湿量(%)
実 施 例	1	5	3.36	0.15	0.45
	2	10	6.40	0.24	0.80
	3	20	27.54	0.26	0.92
	4	5	2.95	0.11	0.44
	5	10	5.78	0.19	0.78
	6	20	23.32	0.23	0.90
	7	5	5.76	0.45	1.02
	8	10	11.05	0.49	1.56
	9	20	28.20	0.55	2.38
	10	5	4.80	0.41	0.95
	11	10	9.70	0.45	1.30
	12	20	23.20	0.56	2.06

[0055]

[Table 2]

		水溶性高分子化合物添加量(%)	吸水量(%)	溶出量(%)	吸湿量(%)
比 較 例	1	5	2.95	1.48	0.55
	2	10	6.80	4.50	0.71
	3	20	7.95	12.55	1.00
	4	5	3.25	2.05	0.60
	5	10	5.76	5.60	0.67
	6	20	13.28	14.40	0.84
	7	0	<0.01	<0.01	<0.01
	8	0	<0.01	<0.01	<0.01

[0056] The example 7 of comparison from the result of above-mentioned Table 1 and 2 and eight articles have a coefficient of water absorption, an elution volume, and the very small amount of moisture absorption. Furthermore, although the coefficient of water absorption and the amount of moisture absorption are also increasing 1-6 examples of comparison compared with 7 or 8 examples of comparison, compared with an example article, these numeric values are small. On the other hand, an example article has a coefficient of water absorption and the large amount of moisture absorption in all, and, moreover, it turns out that the elution volume is suppressed compared with 1-6 examples of comparison.

[Translation done.]